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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appellant:	Chrissan et al.	Examiner:	Azad, A.
Serial No.:	09/392,124	Group Art Unit:	2654
Filed:	September 8, 1999	Docket No.:	8X8S.239PA
Title:	VARYING PULSE AMPLITUDE MULTI-PULSE ANALYSIS SPEECH PROCESSOR AND METHOD		

CERTIFICATE UNDER 37 CFR 1.8: The undersigned hereby certifies that this correspondence and the papers, as described hereinabove, are being deposited in the United States Postal Service **in triplicate**, as first class mail, in an envelope addressed to: Assistant Commissioner for Patents, BOX AF, Washington, D.C. 20231, on March 17, 2003.

By: E. M. Nichols
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APPEAL BRIEF

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BOX AF
Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

This is an Appeal Brief submitted pursuant to 37 CFR §1.192 for the above-referenced patent application and is being filed in triplicate.

I. Real Party in Interest

The real party in interest is Netergy Microelectronics, Inc., a California corporation having a principal place of business at 2445 Mission College Boulevard, Santa Clara, CA 95054. The above-referenced patent application is assigned to Netergy Microelectronics, Inc.

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II. Related Appeals and Interferences

There are no related appeals or interferences.

III. Status of Claims

Claims 1-32 are formally appealed. Claims 1-27 and 29-32 stand rejected under 35 U.S.C. §102(b) as being anticipated by *Bialik et al.* (U.S. Pat. No. 5,568,588); and claim 28 stands rejected under 35 U.S.C. §103(a) as being unpatentable over *Bialik*. The pending claims in their present form may be found in the attached Appendix of Appealed Claims.

IV. Status of Amendments

The application was originally filed on September 8, 1999, including 32 claims. A first Office Action was mailed on January 30, 2002 and in reply, an Office Action Response was filed on July 30, 2002 along with a Petition for Extension of Time. A final Office Action was mailed on October 22, 2002 and in reply, a Response To Final Office Action and a Notice of Appeal were concurrently filed by facsimile on January 16, 2003. An Advisory Action, which included a new citation (U.S. Patent No. 3,624,302) was mailed on February 20, 2003.

V. Summary of Invention

The present invention is directed to a speech processing system including a signal processor arrangement that analyzes an input speech signal and, in response, generates the short-term characteristics of the input speech signal and a target vector. The method includes generating a plurality of sequences of variable-amplitude pulses from the target vector and the short term characteristics, where each of the sequences has a different average amplitude value, and outputting a signal corresponding to a sequence of equal-amplitude pulses which, according to an error criterion, represents the target vector.

The present invention is directed to providing a significant improvement on the multi-pulse speech analysis and synthesis ("MPA") teachings of the *Bialik* '588 reference.

Multi-pulse speech analysis and synthesis typically involves dividing the incoming speech signals into frames and then analyzing each frame to determine its representative components, for example, using a frame analyzer to determine the short-term and long-term characteristics of the speech signal. Typically, one, both, or neither of the long- and short-term predictor contributions are subtracted from the input frame, leaving a target vector whose shape has to be characterized from a multiplicity of samples.

As discussed in the background section of Appellant's Specification, one particular MPA approach is described by the *Bialik* '588 reference. The target vector is modeled by a plurality of pulses of equal amplitude, varying location and varying sign (positive and negative). To select each equal-amplitude pulse, a pulse is placed at each sample location and the effect of the pulse, defined by passing the pulse through a filter defined by the LPC coefficients, is determined. The pulse which provides the filter output that most closely matches the target vector is selected and its effect is removed from the target vector, thereby generating a new target vector. The process

continues until a predetermined number of pulses have been found. For storage or transmission purposes, the result of the MPA analysis is a collection of pulse locations, pulse signs (positive or negative), and a quantized value of the equal pulse amplitude in each sequence.

In the prior art, the MPA output typically specifies the resulting pulse locations, but not the order in which they were chosen. It also specifies only one gain parameter, so the decoder must reconstruct the pulse sequence using equal amplitudes for all the pulses in the sequence.

According to an example embodiment, the present invention significantly improves over the *Bialik* '588 reference by performing a more accurate MPA analysis; an MPA analysis that, from a maximum-likelihood standpoint, has a much better opportunity for determining the best possible pulse sequence to match the target vector because the pulse sequence is reconstructed using varying amplitude pulses in the sequence. By determining a better match to the target, the perceptual quality of the reconstructed speech is significantly improved.

VI. Issues for Review

The issues are as follows:

Issue I: Are the §102(b) rejections of claims 1-27 and 29-32 proper when the *Bialik* '588 reference does not correspond to the claimed invention including, among other limitations, generating a pulse sequence with variable amplitude pulses?

Issue II: Is the §103(a) rejection of claim 28 proper when the prior art teaches away from the claimed invention and the modification proposed by the Examiner?

Issue III: Is the §103(a) rejection of claim 28 proper when the record is void of evidence that would support the modification proposed by the Examiner?

VII. Grouping of Claims

The claims as now presented do not stand and fall together and are separately patentable for the reasons discussed in the Argument. For purposes of this appeal, the claims should be grouped as follows: Group I - claims 1-27 and 29-32; and Group II – claim 28.

VIII. Argument

Appellant submits that the claims of groups I – II are patentably distinguishable from each other and from the cited prior art references. The claims in group I are patentable over the

prior art, because they include subject matter that is not taught or suggested by any of the references cited, including generating from a target vector and short term characteristics, a plurality of sequences of variable-amplitude pulses. The claim of group II is separately patentable over the other claim group because it is directed to subject matter that includes a pulse-train sequence modification function based upon the exponential function, which is not necessarily present in the other claim groups and not taught by the cited prior art.

Issue I: The §102(b) rejections are not proper when the *Bialik* '588 reference does not correspond to the claimed invention including, among other limitations, generating a pulse sequence with variable amplitude pulses.

Contrary to Appellant's claimed invention, the *Bialik* '588 reference does not teach "generating from the target vector and the short term characteristics, a plurality of sequences of variable-amplitude pulses." The §102(b) rejections of claims 1-27 and 29-32 are largely based on the false assertion that column 4, lines 12-51 of the *Bialik* '588 reference teaches this claimed aspect concerning generation of such variable-amplitude pulses (Office Action dated October 22, 2002, at top of p. 3). This citation to column 4, lines 12-51 does not teach or suggest generating any sequence of variable-amplitude pulses. Rather, this portion of the *Bialik* '588 reference expressly contradicts the Examiner's position: the cited discussion concerns operation of *Bialik's* gain level selector 24 and pulse sequence determiner 25 and these '588 blocks provide that for each pulse sequence, there is only one gain level used to define a common amplitude for each such pulse.

Bialik's gain level selector 24 outputs on output line 32 "a current gain level for which sequence of *equal amplitude pulses* is to be determined." See *Bialik* '588 reference, column 4, lines 19-23. Thus, each of *Bialik's* gain levels is for a sequence of *equal amplitude pulses*. The operation of *Bialik's* gain level selector 24 is further characterized at column 5, line 55 through column 6, line 7, where *Bialik* explains that "for each gain index, the first pulse is the location of the pulse determined by pulse location determiner 20 (in steps 44-50). The remaining pulses can be anywhere else within the subframe and can have positive or negative gain values. In step 56, the gain selector 24 stores the first pulse position and its amplitude." Thus, *Bialik's* gain level selector 24 associates each gain index with a pulse sequence (of equal amplitude pulses) by pointing to the first pulse as located by pulse location determiner 20 (see column 4, lines 7-30). Throughout and

particularly in connection with discussion of *Bialik's* gain level selector 24 and pulse sequence determiner 25, the *Bialik* '588 reference unequivocally explains that:

> *The pulse sequence is a series of positive and negative pulses having the current gain level.*

Bialik '588 reference, column 4, lines 29-30. Nowhere does the *Bialik* '588 reference teach that, in connection with *Bialik's* gain level selector 24 and pulse sequence determiner 25, more than one gain level is associated with each pulse sequence.

In further support of Appellant's traversal, reference may be made to column 6, lines 38-42, of the *Bialik* '588 reference where Figs. 3A and 3B are described to illustrate "two examples of different pulse sequence outputs of pulse sequence determiner 25" where the sequence of Fig. 3A has a *single* gain index of 7 and the sequence of Fig. 3B has a *single* gain index of 8. As is inherent through this teaching, each of these figures shows a pulse sequence having a common pulse amplitude. This truth necessarily follows from the *Bialik* '588 reference's teaching that each pulse sequence has only one gain index associated therewith.

The Examiner has also argued (at pages 13-14 in the Response to Arguments section) that equation 6 (column 5) and the associated teaching for the gain level selector 24 (column 4, lines 19-23) "would clearly correspond" to Appellant's claimed generation of a pulse sequence having pulses of variable-amplitudes. However, as explained above, the *Bialik* '588 reference does not associate more than one gain level with each pulse sequence.

Accordingly, it is untenable for the Examiner to argue that the *Bialik* '588 reference would be interpreted to teach, as claimed, generation of a plurality of sequences of variable-amplitude pulses.

In view of the above, the Examiner failed to meet the requirements for establishing a *prima facie* §102(b) rejection. Specifically, all the claim limitations are not anticipated by the prior art. Therefore, the §102(b) rejection is improper and must be removed.

Issue II: The §103(a) rejection of claim 28 is not proper when the prior art teaches away from the claimed invention and the modification proposed by the Examiner.

Appellant's invention is directed to a plurality of sequences of variable-amplitude pulses, whereby the amplitudes of the pulses within a single sequence are different and related by a

mathematical formula. In contrast, the '588 reference is directed to a plurality of sequences of equal-amplitude pulses wherein each sequence in the plurality of sequences has a different gain value. The pulses within a single sequence of the '588 reference are of equal-amplitude and therefore not structured and related by a mathematical formula (*e.g.*, exponential function).

In contrast and as discussed above, the *Bialik* '588 reference selects a gain level for each sequence of pulses, and for each pulse sequence of the *Bialik* '588 reference, there is only one gain level and each such pulse therefore has the same amplitude. As stated in the Summary of the *Bialik* '588 reference, each pulse sequence is processed (measured, filtered, compared, *etc.*) as a "single gain pulse sequence" (column 2, lines 7-15).

The Examiner erroneously asserts that the skilled artisan would be lead by the prior art to modify the '588 reference to modify the *Bialik* '588 reference so that it uses an exponential modification function to provide pulses of varying amplitude in each pulse-train sequence because this would allegedly improve output speech quality. Appellant submits that modifying the *Bialik* '588 reference in this regard would not improve output speech quality because the functional blocks described by the *Bialik* '588 reference would still operate under the design principle that the pulses in each pulse-train sequence have the same amplitude. Thus, the Examiner's assertion is illogical.

The Examiner's assertion in this regard would also undermine the operation and objectives of the *Bialik* '588 reference. As stated in the Summary of the *Bialik* '588 reference and discussed above, each pulse sequence has a single gain level and each pulse sequence is processed as this "single gain pulse sequence" (column 2, line 11). The Examiner's proposed modification, however, would result in a different set of objectives, in an inaccurate "perceptual weighting filter" (column 2, lines 11-12), an inoperable gain selector, and due to a set of unmappable gain levels for each pulse sequence, such pulse sequences which would not be identifiable to "minimize the energy of the error vector and its corresponding gain level" (column 2, lines 12-15). According to long-standing case law, modifying a reference in a manner that undermines its operation and/or objectives is *per se* evidence that the prior art teaches away from the claimed invention. *See, e.g.*, In re Gordon, 733 F.2d 900, 221 U.S.P.Q. 1125 (Fed. Cir. 1984) (A §103 rejection cannot be maintained when the asserted modification undermines the purpose of the main reference.)

Moreover, consistent with the discussion above, Appellant submits that the asserted prior art fails to teach all aspects of claim 28 and further fails to teach (as acknowledged at page 13)

modifying the pulse train based on the exponential function. The Examiner took "Official Notice" as to it being "well-known in the art of speech processes to use pulse trains constructed based on the exponential function." In his Response to Arguments, the Examiner stated that a reference (not provided or cited) is provided to show "that it is well known that pulse-train sequence modification function is based on the exponential function." Appellant could only guess as to this source. If the alluded-to reference had been Section 5.5 of Discrete-Time Processing of Speech Signals by Deller, Hansen and Proakis, Appellant did not find therein any such teachings. Appellant could only find references to Pitch and Formant estimation and was unable to see where the reference teaches searching multi-pulse sequences in order to code a speech excitation. Thusly, Appellant maintained its traversal of this "Official Notice" in the Final Response, and here submits that the rejection fails to provide a *prima facie* case of obviousness in regard to correspondence to the claimed invention and evidence of motivation for the alleged combination.

As mandated by the requirements of 35 U.S.C. §132, Appellant twice requested that the Examiner provide such alleged reference(s) which would support the rejection and the "Official Notice." A physical copy of this reference was never provided; but reference to it (U.S. Patent No. 3,624,302) was newly made in the Advisory Action dated February 20, 2003.

Issue III: The §103(a) rejection of claim 28 is not proper when the record is void of evidence that would support the modification proposed by the Examiner.

The Examiner has failed to provide evidence of motivation for making the asserted modification of the '588 reference. As discussed above, the Examiner's citations evidence that the only prior art of record teaches away from the claimed invention. It is not Appellant's burden, however, to establish these truths.

Specifically, to support a *prima facie* case of obviousness in connection with such a modification of the '588 reference, the Examiner must specifically identify clear and particular reasons that indicate why one of ordinary skill in the art would have been motivated to select the missing claim limitations and modify the '588 reference with them. *See, e.g.*, In re Dembiczak, 175 F.3d 994, 50 U.S.P.Q.2d 1614 (Fed. Cir. 1999). Evidence has not been provided of any teaching or suggestion for using the '588 reference in connection with modifying the pulse-train sequence based on the exponential function, as claimed in the instant invention, or for modifying the reference to achieve the claimed limitations. The law requires that evidence of motivation

must be specifically identified and shown by some objective teaching in the prior art leading to the modification. "Our court has provided [that the] motivation to combine may be found explicitly or implicitly: 1) in the *prior art references* themselves; 2) in the knowledge of those of ordinary skill in the art that certain *references*, or disclosures in those references, are of special interest or importance in the field; or 3) from the nature of the problem to be solved, 'leading inventors to look to *references* relating to possible solutions to that problem.'" Ruiz v. A.B. Chance Co., 234 F.3 654, 57 U.S.P.Q.2d 1161 (Fed. Cir. 2000). The Office Action fails to identify evidence of why one skilled in the art would be led to modify the '588 reference, and does not provide any evidence of factual teachings, suggestions or incentives from the prior art that lead to the proposed modification.

The Examiner failed to cite any evidence in support of this modification.

In view of the above, the Examiner failed to meet the requirements for establishing a *prima facie* §103(a) rejection. Specifically, all the claim limitations are not taught or suggested by the prior art. Therefore, the §103(a) rejection is improper and must be reversed.

IX. Conclusion

In view of the above, Appellant believes the claimed invention to be patentable. Claims 1-32 remain for consideration. Appellant respectfully requests reversal of the rejection as applied to the appealed claims and allowance of the entire patent application.

Please charge Deposit Account 50-0996 (8X8.239PA) in the amount of $320 for a Brief in support of an appeal as set forth in 37 C.F.R. §1.17(c).

Respectfully submitted,

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APPENDIX OF APPEALED CLAIMS (S/N 09/392,124)

1. In a speech processing system including a signal processor arrangement that analyzes an input speech signal and, in response, generates the short-term characteristics of the input speech signal and a target vector, a method of analyzing the input speech signal comprising:

generating from the target vector and the short term characteristics, a plurality of sequences of variable-amplitude pulses, each of the sequences having a different average amplitude value; and

outputting a signal corresponding to a sequence of equal-amplitude pulses which, according to an error criterion, represents the target vector.

2. A system according to claim 1, wherein the target vector is matched using a perceptual weighting criterion.

3. A speech processing system including a signal processor arrangement that analyzes an input speech signal and, in response, generates the short-term characteristics of the input speech signal and a target vector, comprising:

means for generating from the target vector and the short term characteristics, a plurality of sequences of variable-amplitude pulses, each of the sequences having a different average amplitude value; and

means for outputting a signal corresponding to a sequence of equal-amplitude pulses which, according to an error criterion, represents the target vector.

4. A system according to claim 3, wherein the target vector is matched using a perceptual weighting criterion.

5. A speech processing system including a signal processor arrangement that analyzes an input speech signal and, in response, generates the short-term characteristics of the input speech signal and a target vector, comprising:

an analyzer adapted to receive the target vector and the short term characteristics and to generate a plurality of sequences of variable-amplitude pulses, each of said sequences having a different average amplitude value;

the analyzer being further adapted to output a signal corresponding to a sequence of equal-amplitude pulses which, according to an error criterion, represents the target vector.

6. A system according to claim 5, wherein the target vector is matched using a perceptual weighting criterion.

7. A speech processing system including a signal processor arrangement that analyzes an input speech signal and, in response, generates the short-term characteristics of the input speech signal and a target vector, comprising:

a multi-pulse analyzer adapted to receive the target vector and the short term characteristics and to generate a plurality of sequences of variable-amplitude, variable-sign and variably-spaced pulses, each of said sequences having a different average amplitude value, each of said pulses within each sequence having variable amplitudes and variable signs;

the multi-pulse analyzer being further adapted to output a signal corresponding to a sequence of equal-amplitude, variable-sign, variably-spaced pulses which, according to a maximum likelihood criterion, most closely represents the target vector.

8. A system according to claim 7, wherein the target vector is matched using a perceptual weighting criterion.

9. A system according to claim 7, wherein the pulse amplitude variations are based on at least one of: the exponential function; a linear function; the short-term characteristics of the input speech signal; the long-term characteristics of the input speech signal; and the excitation signal from previous frames.

10. A speech processing system comprising:

a short-term analyzer that analyzes an input speech signal, and in response to said input speech signal, generates the short-term characteristics of the input speech signal;

a target vector generator for generating data including a target vector from at least said input speech signal, and optionally, said short-term characteristics; and

a multi-pulse analyzer adapted to receive the target vector and the short term characteristics and to generate a plurality of sequences of variable amplitude, variable sign, variably-spaced pulses, each of said sequences having a different average amplitude value, each of said pulses within each sequence having variable amplitudes and variable signs, said multi-pulse analyzer for outputting a signal corresponding to the sequence of equal amplitude, variable sign, variably spaced pulses which, according to a maximum likelihood criterion, most closely represents said target vector.

11. A system according to claim 10, wherein the target vector is matched using a perceptual weighting criterion; and

wherein the pulse amplitude variations are based on at least one of: the exponential function; a linear function; the short-term characteristics of the input speech signal; the long-term characteristics of the input speech signal; and the excitation signal from previous frames.

12. A speech processing system comprising:

a short-term analyzer that analyzes an input speech signal, and in response to said input speech signal, generates the short-term characteristics of the input speech signal;

a target vector generator for generating a target vector from at least said input speech signal, and optionally, said short-term characteristics; and

a multi-pulse analyzer connected to an output line of said target vector generator and an output line of said short term analyzer, wherein said multi-pulse analyzer generates a plurality of sequences of variable amplitude, variable sign, variably spaced pulses, each of said sequences having a different average amplitude value, each of said pulses within each sequence having variable amplitudes and variable signs, said multi-pulse analyzer for outputting a signal corresponding to the sequence of variable amplitude, variable sign, variably spaced pulses which, according to the maximum likelihood criterion, most closely represents said target vector.

13. A system according to claim 12, wherein the target vector is matched using a perceptual weighting criterion.

14. A system according to claim 13, wherein the pulse amplitude variations are based on at least one of: the exponential function; a linear function; the short-term characteristics of the input speech signal; the long-term characteristics of the input speech signal; and the excitation signal from previous frames.

15. A speech processing system comprising:

a short-term analyzer that analyzes an input speech signal, and in response to said input speech signal, generates the short-term characteristics of the input speech signal;

a target vector generator for generating a target vector from at least said input speech signal, and optionally, said short-term characteristics; and

a multi-pulse analyzer connected to an output line of said target vector generator and an output line of said short term analyzer, wherein said multi-pulse analyzer generates a plurality of sequences of variable amplitude, variable sign, variably spaced pulses, each of said sequences having a different average amplitude value, each of said pulses within each sequence having variable amplitudes and variable signs, said multi-pulse analyzer for outputting a signal corresponding to the sequence of variable amplitude, variable sign, variably spaced pulses which, according to the maximum likelihood criterion, most closely represents said target vector, and

one or more pulse sequence modifiers, each having as input at least a sequence of equal amplitude, variable sign, variably spaced pulses, wherein each said pulse sequence modifier modifies its input sequence and produces as output a sequence of variable amplitude, variable sign, variably spaced pulses.

16. A system according to claim 15 wherein the pulse sequence modification function is based on at least one of: the exponential function; a linear function; the short-term characteristics of the input speech signal; the long-term characteristics of the input speech signal; and the excitation signal from previous frames.

17. A speech processing system comprising:

a short-term analyzer that analyzes an input speech signal, and in response to said input speech signal, generates the short-term characteristics of the input speech signal;

a long-term analyzer that analyzes an input speech signal, and in response to said input speech signal, generates the long-term characteristics of the input speech signal;

a target vector generator for generating a target vector from at least said input speech signal, and optionally, said short-term characteristics, and optionally, said long-term characteristics; and

a pulse-train sequence analyzer connected to at least an output line of said target vector generator and an output line of said short term analyzer, wherein said pulse-train sequence analyzer generates a plurality of sequences of variable amplitude, variable sign, variably spaced pulse trains, each of said sequences having a different average amplitude value, each of said pulse trains within each sequence having variable amplitudes and variable signs, said pulse-train sequence analyzer for outputting a signal corresponding to the sequence of equal amplitude, variable sign, variably spaced pulse trains which, according to the maximum likelihood criterion, most closely represents said target vector.

18. A system according to claim 17, wherein the pulse amplitude variations are based on at least one of: the exponential function; a linear function; the short-term characteristics of the input speech signal; the long-term characteristics of the input speech signal; and the excitation signal from previous frames.

19. A system according to claim 18, wherein the target vector is matched using a perceptual weighting criterion.

20. A speech processing system comprising:

a short-term analyzer that analyzes an input speech signal, and in response to said input speech signal, generates the short-term characteristics of the input speech signal;

a long-term analyzer that analyzes an input speech signal, and in response to said input speech signal, generates the long-term characteristics of the input speech signal;

a target vector generator for generating a target vector from at least said input speech signal, and optionally, said short-term characteristics, and optionally, said long-term characteristics; and

a pulse-train sequence analyzer connected to at least an output line of said target vector generator and an output line of said short term analyzer, wherein said pulse-train sequence analyzer generates a plurality of sequences of variable amplitude, variable sign, variably spaced pulse trains, each of said sequences having a different average amplitude value, each of said pulse trains within each sequence having variable amplitudes and variable signs, said pulse-train sequence analyzer for outputting a signal corresponding to the sequence of variable amplitude, variable sign, variably spaced pulse trains which, according to the maximum likelihood criterion, most closely represents said target vector.

21. A system according to claim 20, wherein the target vector is matched using a perceptual weighting criterion.

22. A system according to claim 20, wherein the pulse amplitude variations are based on at least one of: the exponential function; a linear function; the short-term characteristics of the input speech signal; the long-term characteristics of the input speech signal; and the excitation signal from previous frames.

23. A system according to claim 21, wherein the pulse amplitude variations are based on at least one of: the exponential function; a linear function; the short-term characteristics of the input speech signal; the long-term characteristics of the input speech signal; and the excitation signal from previous frames.

24. A system according to claim 21 wherein the pulse amplitude variations are based on at least one of: the exponential function; a linear function; and characteristics of the input speech signal.

25. A speech processing system comprising:

a short-term analyzer that analyzes an input speech signal, and in response to said input speech signal, generates the short-term characteristics of the input speech signal;

a long-term analyzer that analyzes an input speech signal, and in response to said input speech signal, generates the long-term characteristics of the input speech signal;

a target vector generator for generating a target vector from at least said input speech signal, and optionally, said short-term characteristics, and optionally, said long-term characteristics; and

a pulse-train sequence analyzer connected to at least an output line of said target vector generator and an output line of said short term analyzer, wherein said pulse-train sequence analyzer generates a plurality of sequences of variable amplitude, variable sign, variably spaced pulse trains, each of said sequences having a different average amplitude value, each of said pulse trains within each sequence having variable amplitudes and variable signs, said pulse-train sequence analyzer for outputting a signal corresponding to the sequence of variable amplitude, variable sign, variably spaced pulse trains which, according to the maximum likelihood criterion, most closely represents said target vector, and

one or more pulse-train sequence modifiers, each having as input at least a sequence of equal amplitude, variable sign, variably spaced pulse trains, wherein each said pulse sequence modifier modifies its input sequence and produces as output a sequence of variable amplitude, variable sign, variably spaced pulse trains.

26. A system according to claim 25, wherein the target vector is matched using a perceptual weighting criterion.

27. A system according to claim 25, wherein the pulse amplitude variations are based on at least one of: the exponential function; a linear function; the short-term characteristics of the input speech signal; the long-term characteristics of the input speech signal; and the excitation signal from previous frames.

28. A system according to claim 25, wherein the pulse-train sequence modification function is based on the exponential function.

29. A system according to claim 25, wherein the pulse-train sequence modification function is based on a linear function.

30. A system according to claim 25, wherein the pulse-train sequence modification function is based on the short-term characteristics of the input speech signal.

31. A system according to claim 25, wherein the pulse-train sequence modification is based on the long-term characteristics of the input speech signal.

32. A system according to claim 25, wherein the pulse-train sequence modification function is based on the excitation signal from previous frames.